Statistical analysis of weather types over the Iberian peninsula domain.

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Summary

- Brief Introduction
- Data
- Recent Observed Changes
- Weather Types (Clustering)
- Statistical Analysis comparing two periods
- Conclusions

In nature there is a perfect causal relationship between atmospheric states and meteorological phenomena, so the observed recent changes in the latter must be an effect of changes in the former.

"And at what point does it stop being 'good for the garden'?"

Zorita,E. and Von Storch, H. (1999). The analog method as a simple statistical downscaling technique: Comparison with more complicates methods. *Journal of Climate, 12:2474-2489.*

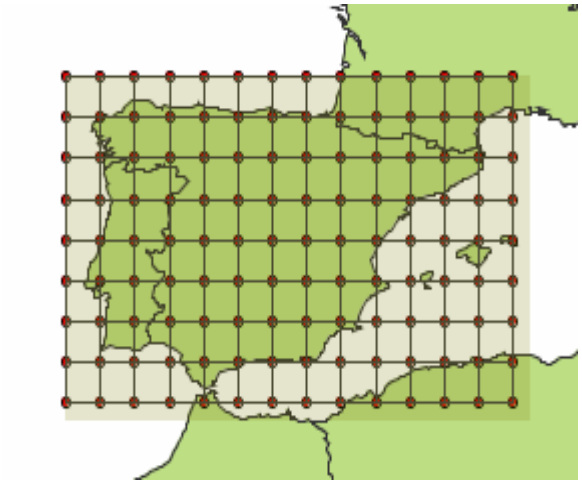
Data

To perform our analysis we combine two types of information:
The modeled atmospheric state and the observed surface phenomena.

Daily period 1957-2002

We use ACMs to simulate the atmosphere state 4-D '*monster*'.

ERA-40 T159L60

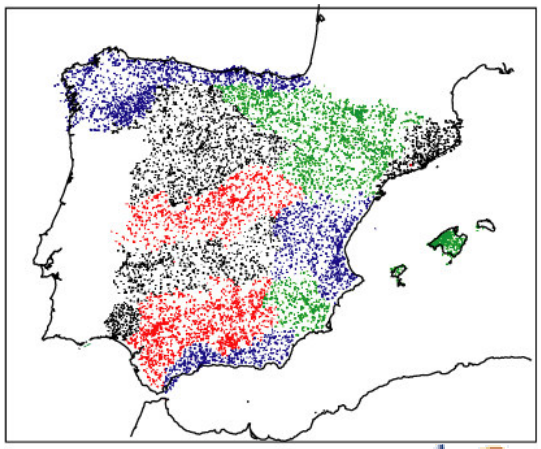


ECMWF

Daily period 1930-2004

And Observation Networks to sample phenomena.

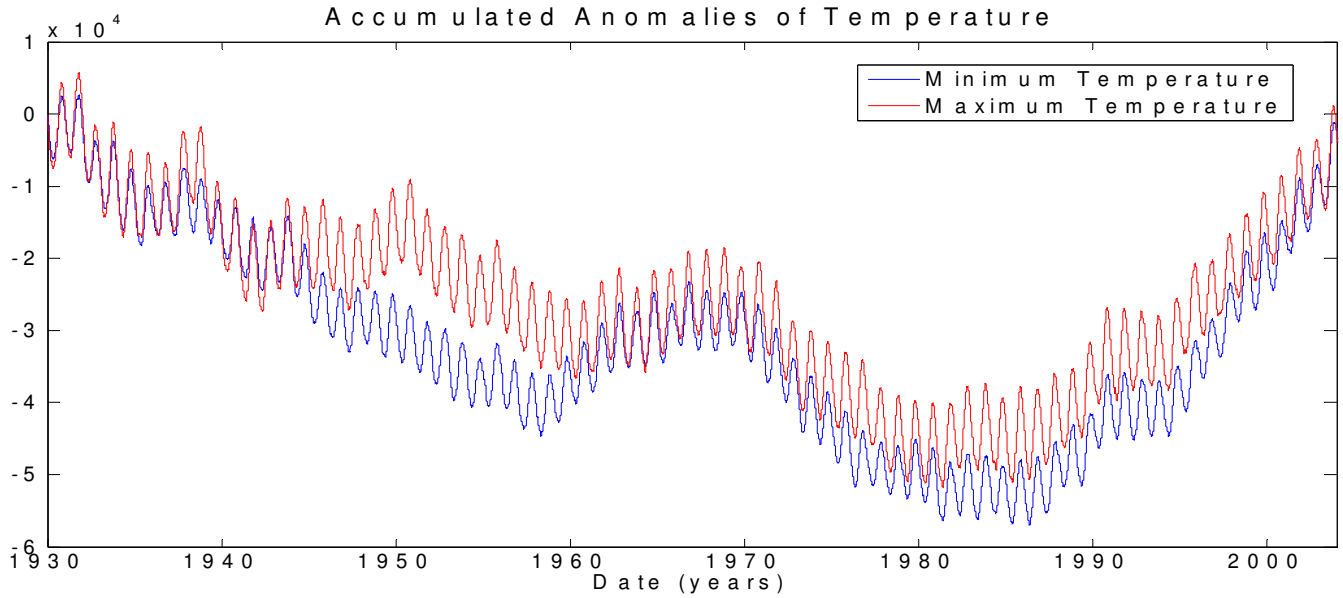
Temperature (216)
Precipitation (3254)

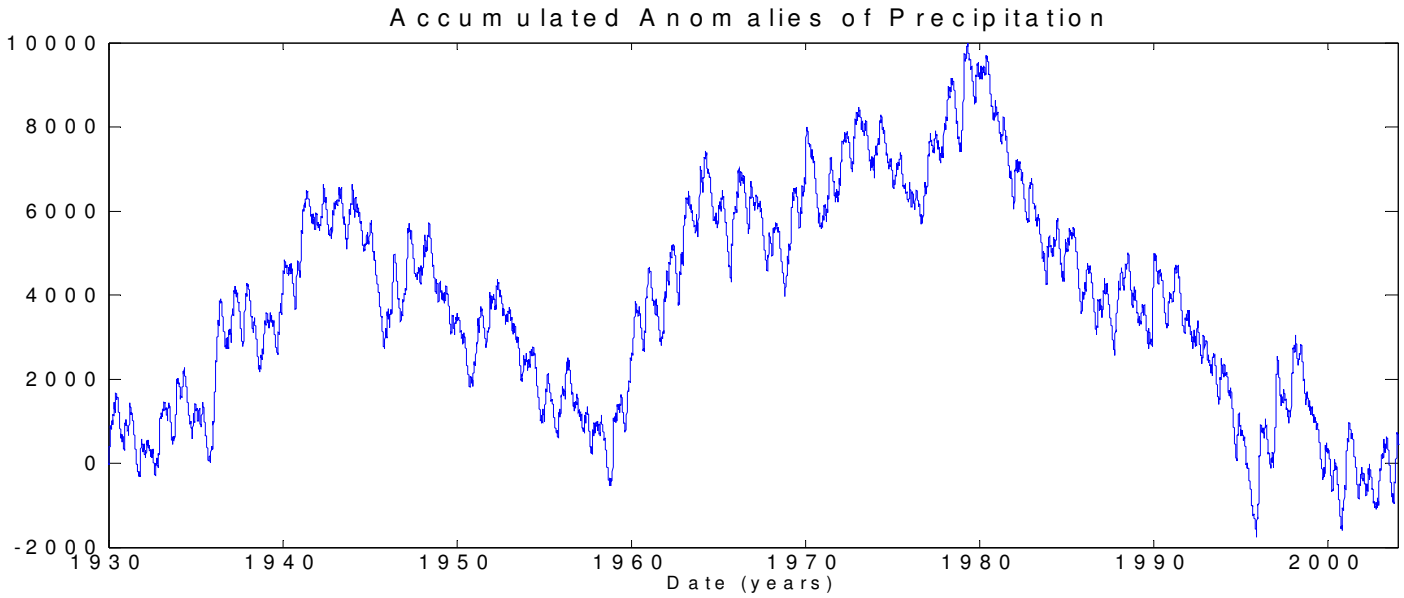


AEMet
Agencia Estatal de Meteorología

Gutiérrez, J.M., Cano, R., Cofiño, A.S., and Sordo, C.M. (2004b). Redes Probabilísticas y Neuronales en las Ciencias Atmosféricas. *Monografías del Ministerio e Medio Ambiente.*

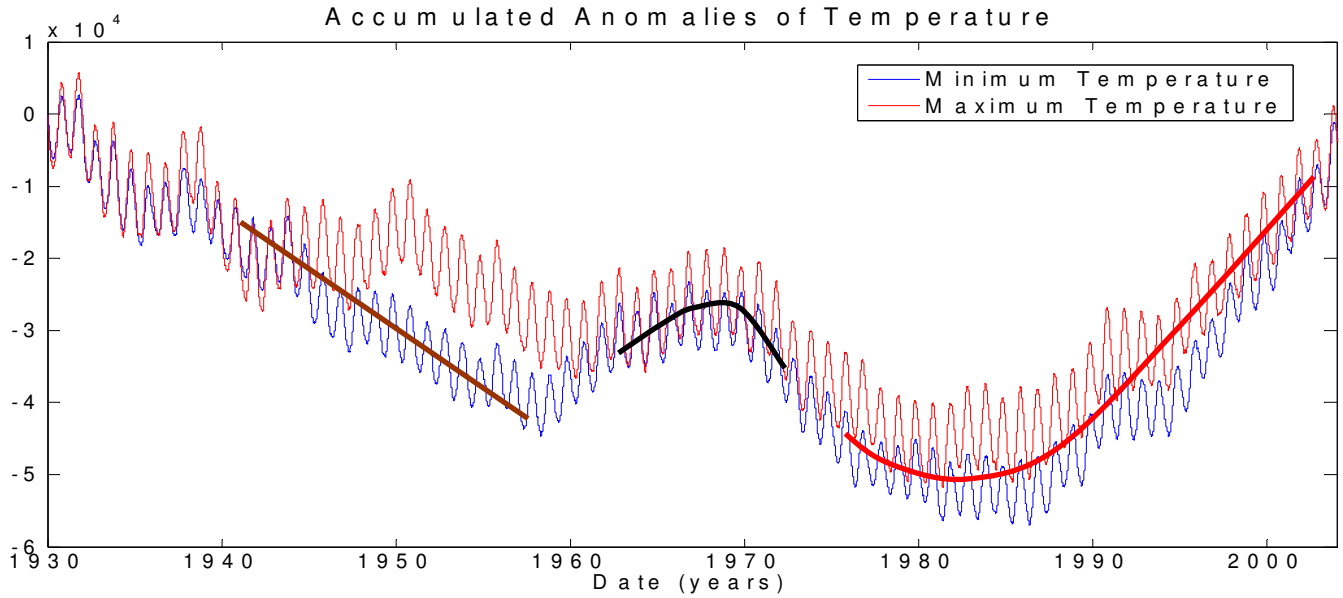
Recent Observed Changes

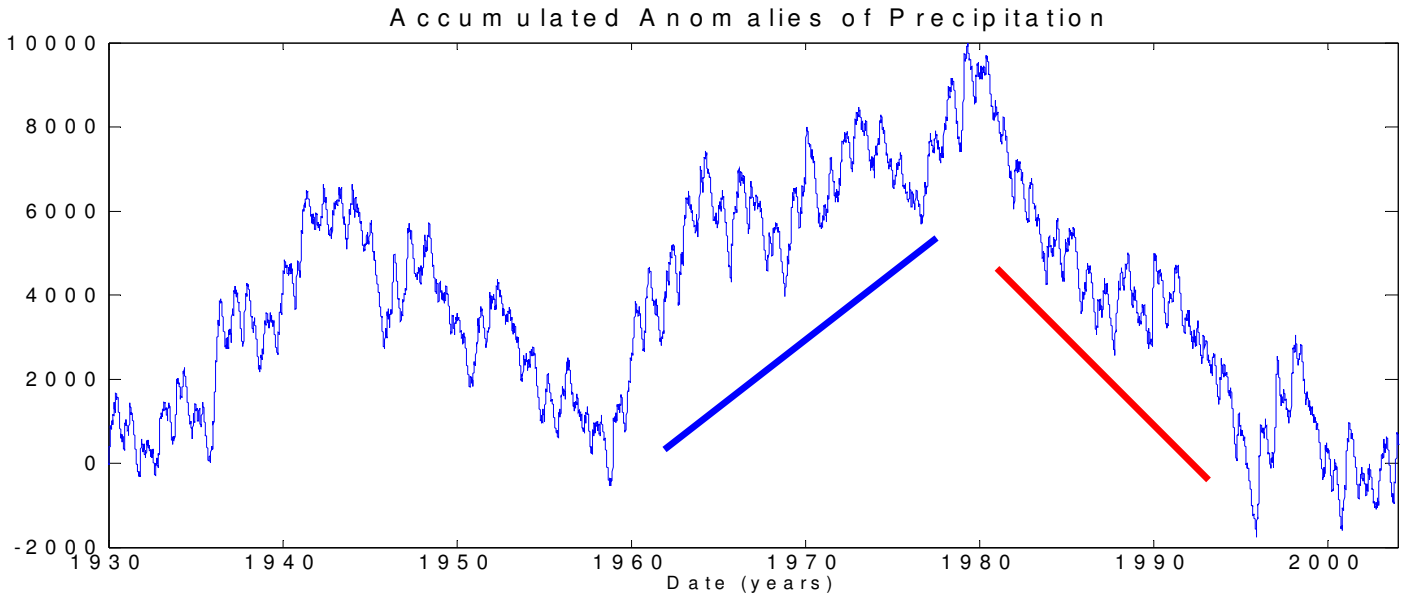




Brunet, M. et. al. (2007), Temporal and spatial temperature variability and change over Spain during 1850–2005, J. Geophys. Res., 112

Recent Observed Changes





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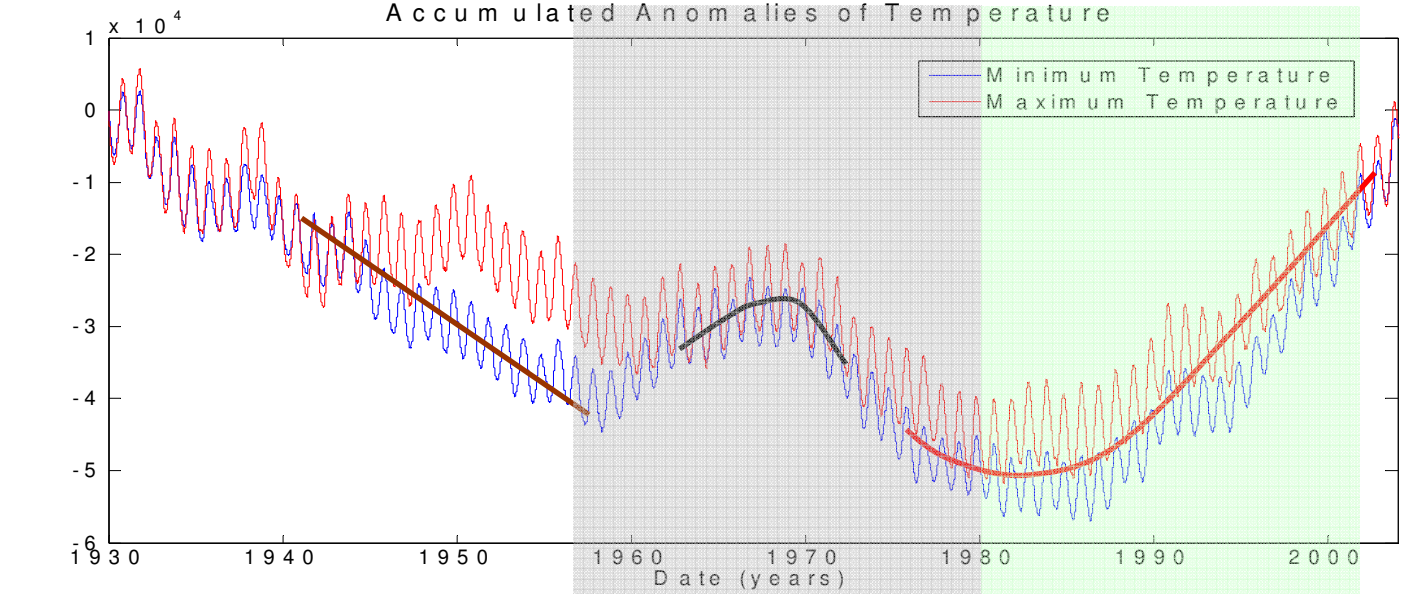
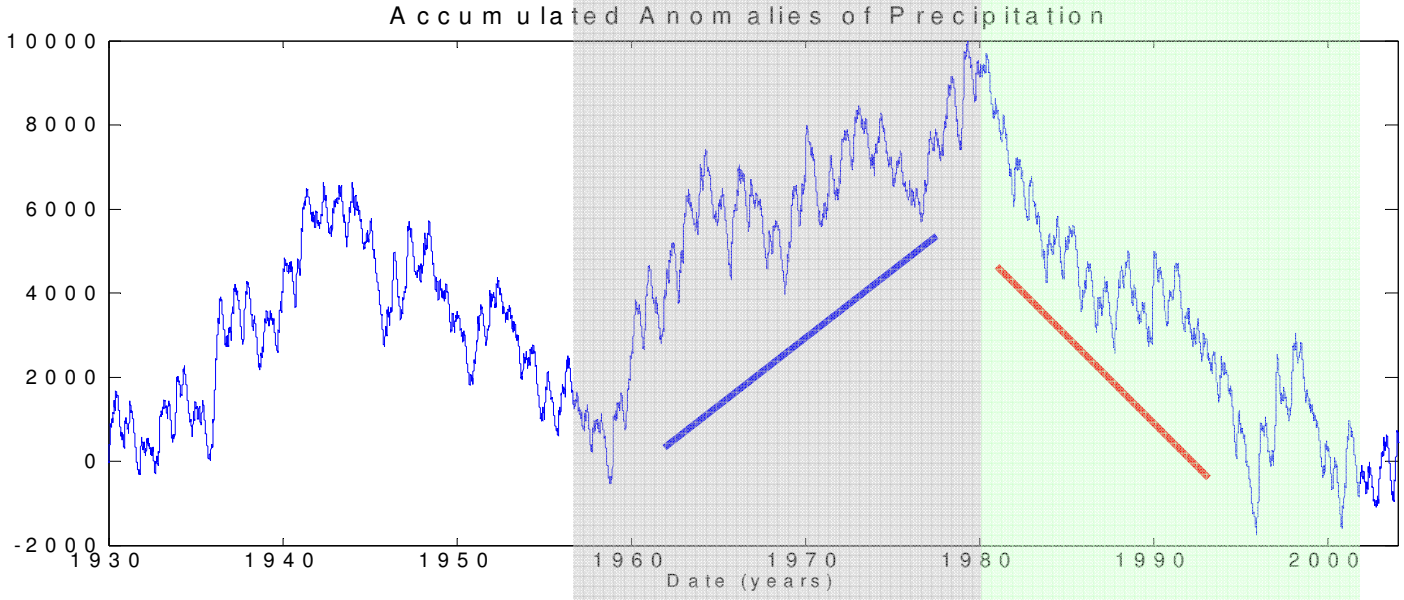
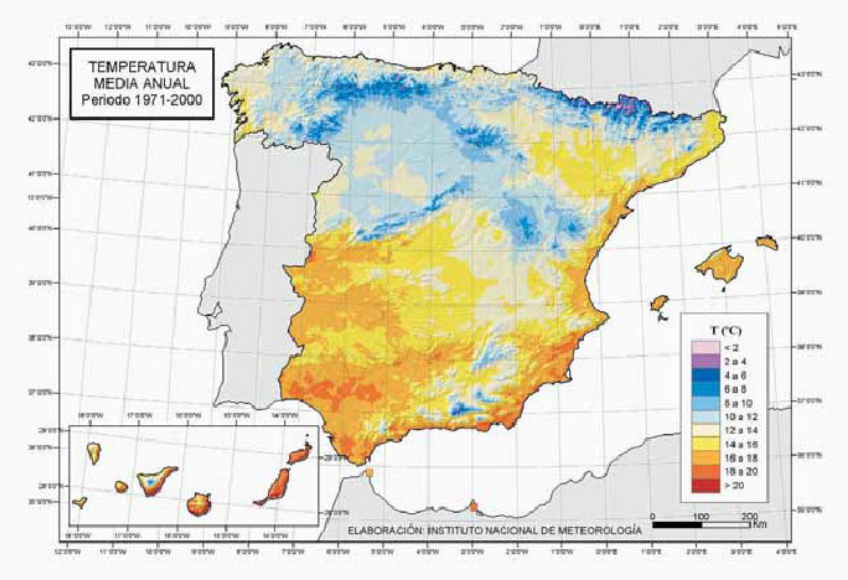
Recent Observed Changes

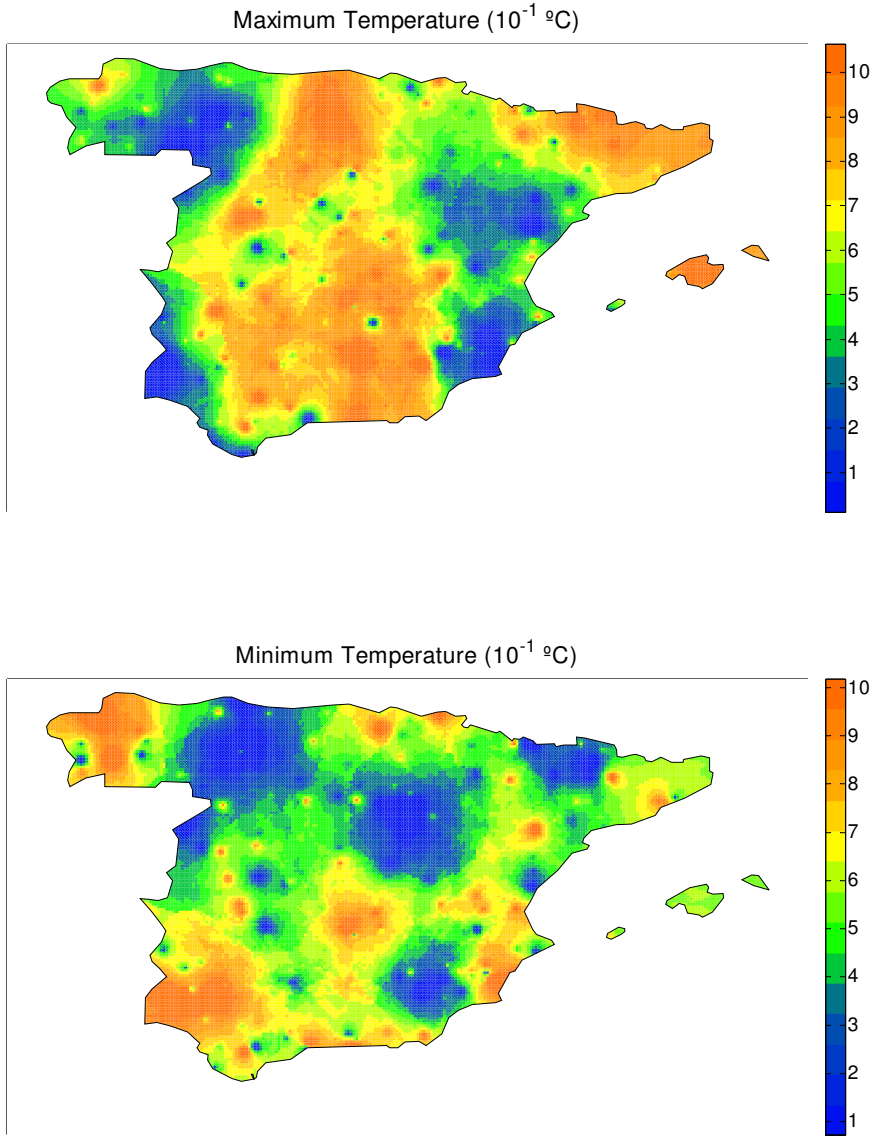




Brunet, M. et. al. (2007), Temporal and spatial temperature variability and change over Spain during 1850–2005, J. Geophys. Res., 112

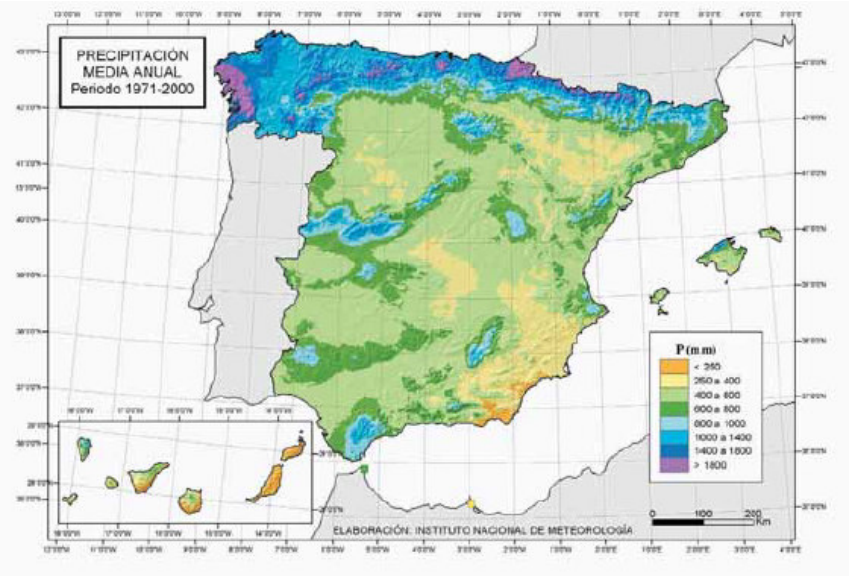
Recent Observed Changes in Temperature

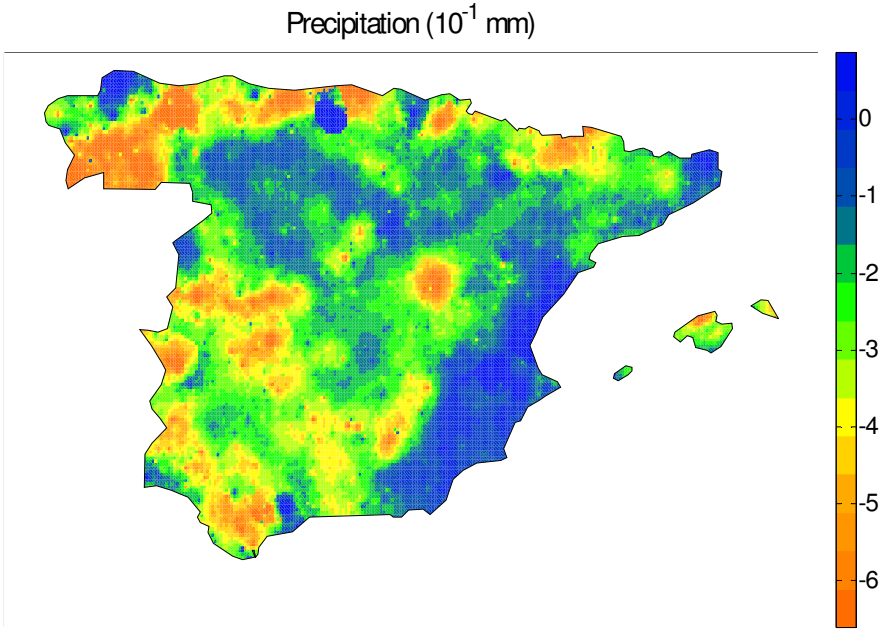




Alexander, L.V., et al. Global observed changes in daily climate extremes of temperature and precipitation. *J. Geophys. Res., 2006.*

Recent Observed Changes in Precipitation





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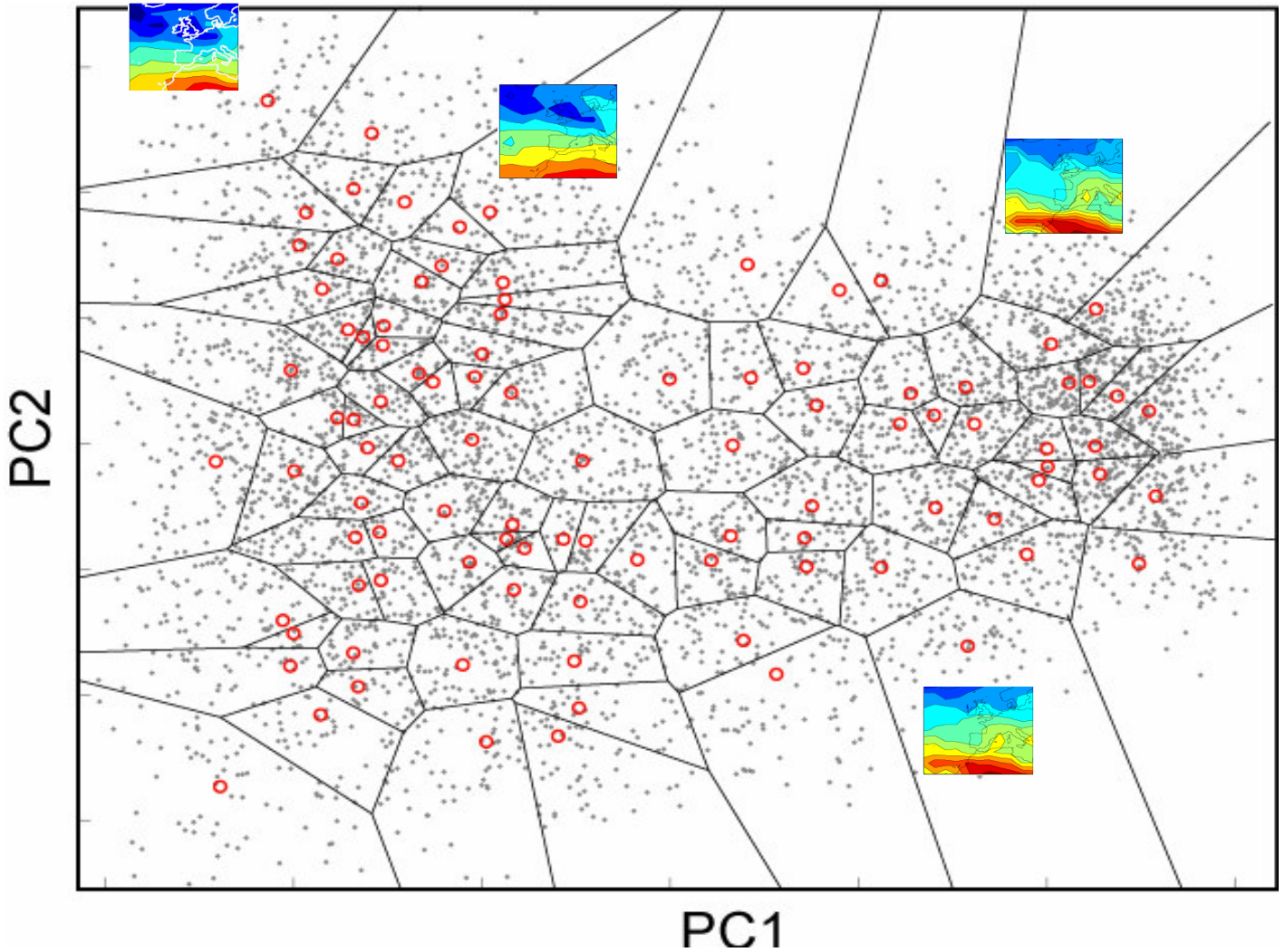
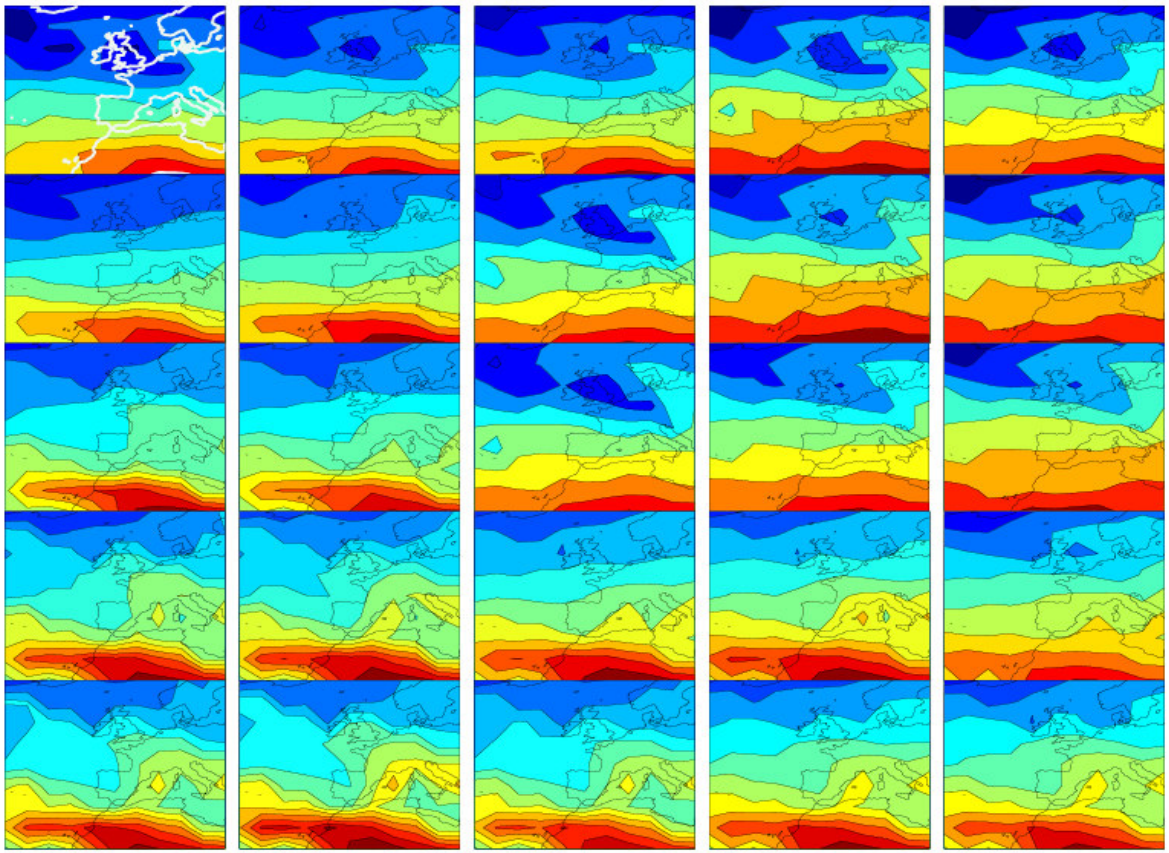
WEATHER TYPING
K-means clustering of atmospheric states



Cano R., Cofiño, A., Lopez, F. Gutiérrez, J.,and Rodríguez, M. (2001). Aplicación de métodos de clasificación al downscaling estadístico. *Actas del V Simposio Nacional de Predicción, pp. 49-50*. Instituto Nacional de Meteorología.

WEATHER TYPING
SOM clustering of atmospheric states

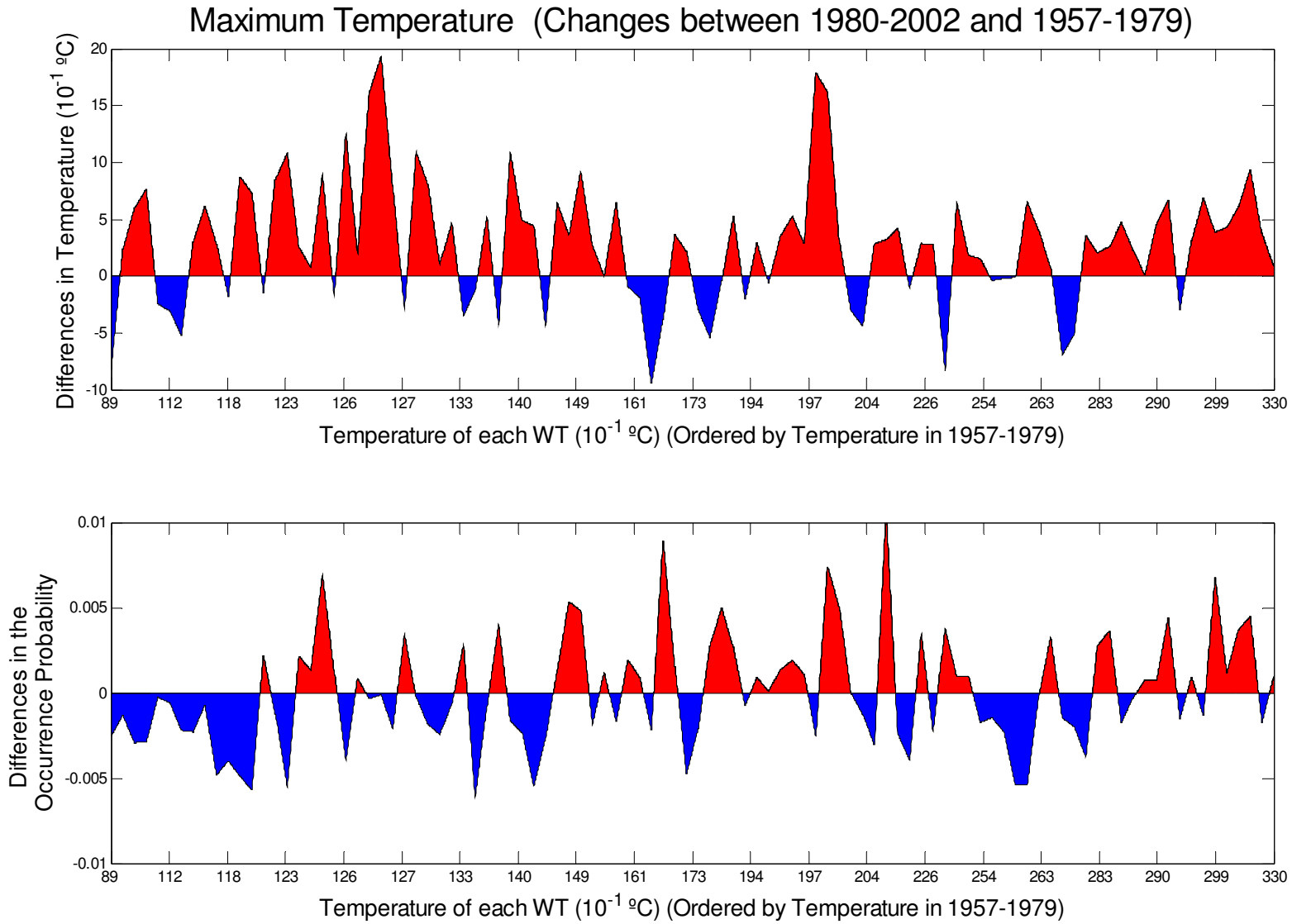
To analyze the behavior of the atmospheric states under different conditions, they have been classified in 100 weather types, using a SOM.



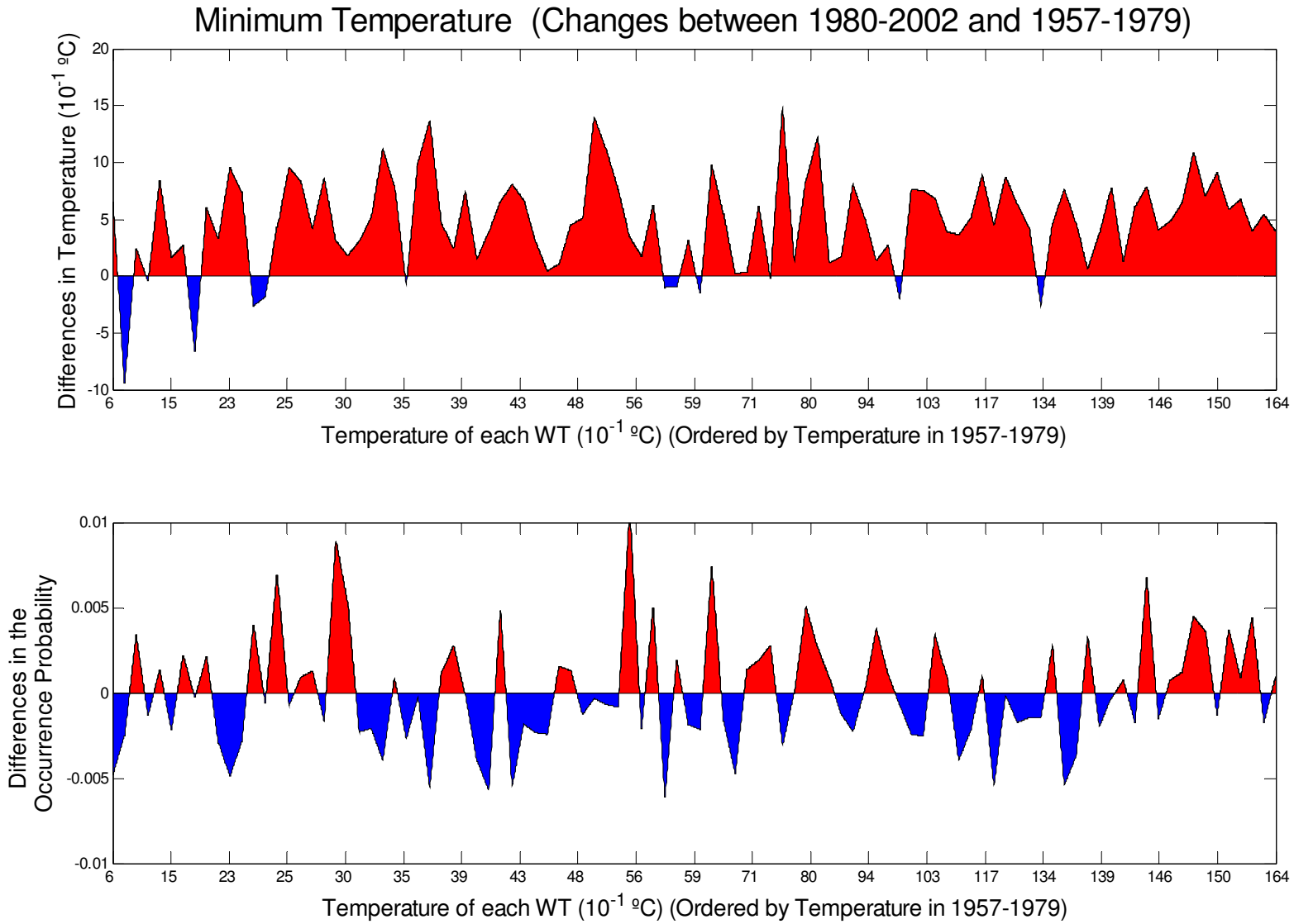
EXAMPLE of Surface temperature fields in a 5x5 lattice of weather types.

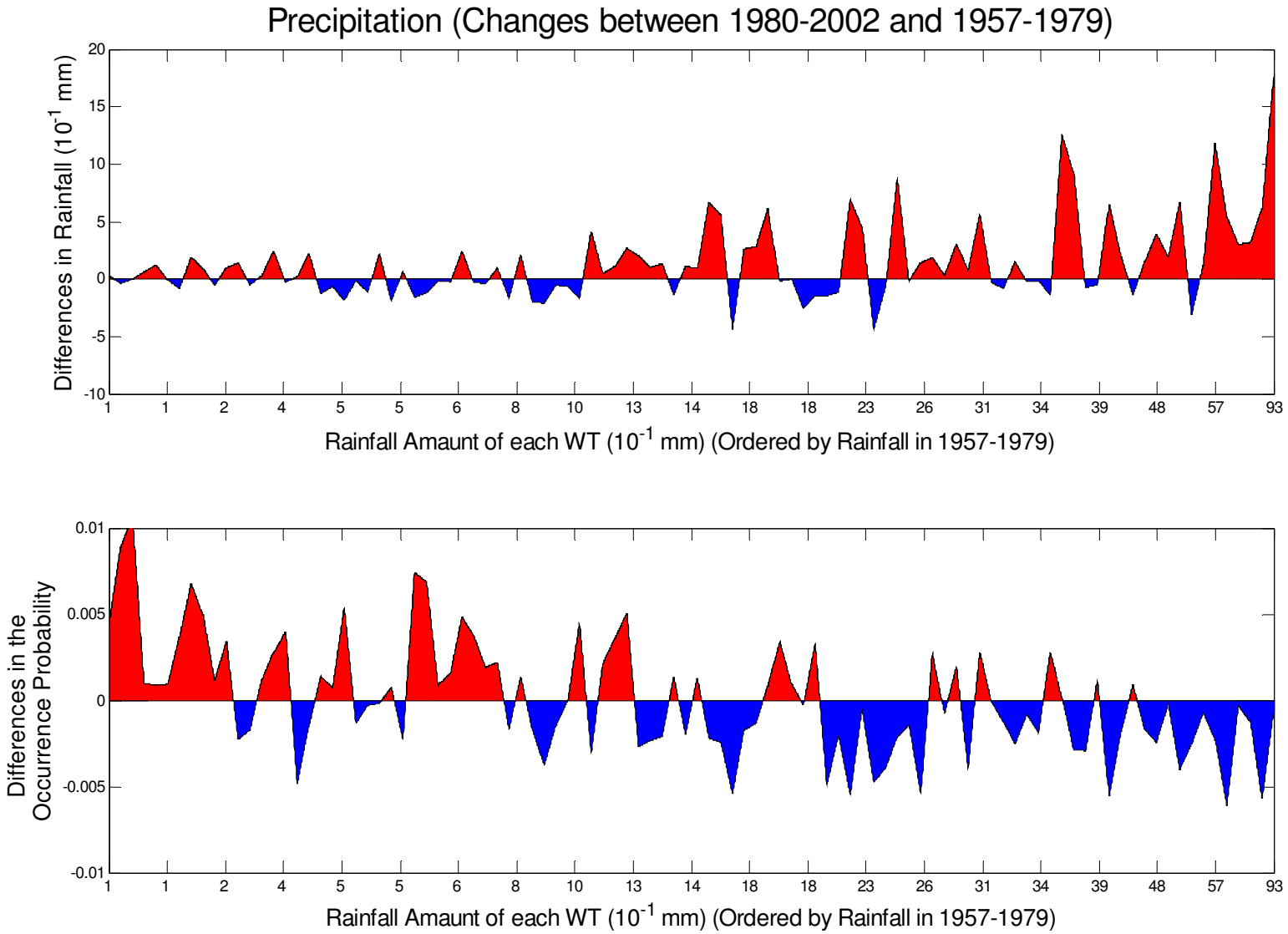
Every weather type has three main features which are: occurrence probability, mean values (precipitation or temperature), and the transition probabilities.

Eckert, P., Cattani, D., ando Ambühl, J. (1996). Classification of ensemble forecast by means of an artificial neural network. *Meteor. Appl., 3:169-178.*



Rodríguez-Puebla, C., M. D. Frías, and A. H. Encinas (2004), Relaciones entre los extremos de temperatura máxima y patrones de circulación en el Atlántico Norte. paper presented at *XXVIII Jornadas Científicas. La Meteorología y clima Atlánticos. 5o Encuentro Hispano-Luso de Meteorología, Badajoz, Spain, 11 –13 February, Pub. de la Asociación Española de Meteorología, 6 pp.*


Minimum Temperature (Changes between 1980-2002 and 1957-1979)
Differences in Temperature (10-1 ºC)
20
15
10
5
0
-5
-10
6 15 23 25 30 35 39 43 48 56 59 71 80 94 103 117 134 139 146 150 164
Temperature of each WT (10-1 ºC) (Ordered by Temperature in 1957-1979)
Differences in the Occurrence Probability
0.01
0.005
0
-0.005
-0.01
6 15 23 25 30 35 39 43 48 56 59 71 80 94 103 117 134 139 146 150 164
Temperature of each WT (10-1 ºC) (Ordered by Temperature in 1957-1979)


Precipitation (Changes between 1980-2002 and 1957-1979)
Differences in Rainfall (10^{-1} mm)
20
15
10
5
0
-5
-10
1 1 2 4 5 5 6 8 10 13 14 18 18 23 26 31 34 39 48 57 93
Rainfall Amaunt of each WT (10^{-1} mm) (Ordered by Rainfall in 1957-1979)
Differences in the Occurrence Probability
0.01
0.005
0
-0.005
-0.01
1 1 2 4 5 5 6 8 10 13 14 18 18 23 26 31 34 39 48 57 93
Rainfall Amaunt of each WT (10^{-1} mm) (Ordered by Rainfall in 1957-1979)

Conclusions

- Changes in the observed phenomena are driven by changes in the local atmospheric conditions, which are potentially associated with the intensity, frequency and evolution of the different patterns

- There have been no significant changes in the intensity of the phenomenology associated with the different WTs, although small general changes have been noticed

- Most of the important changes are related with the Occurrence Probability of WTs, especially in those associated with extreme events of Temperature and Precipitacion

Conclusions

- **Temperature**:
  - Uniform changes in Temperature (positive changes)
  - Frequency of warm classes increases, while frequency of cool ones decreases
  - Temperature has increased since 1980
- **Precipitation**:
  - Changes in Precipitation are only present in intense events (also positive changes)
  - Frequency of dry classes increases, while frequency of wet ones decreases
  - Rainfall Amount has decreased since 1980

Questions?